

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Bruce E. Kreischer §
Serial No.: 10/792,108 § Group Art Unit: 1797
Filed: March 3, 2004 § Examiner: Randy Boyer
For: A METHOD AND SYSTEM FOR SEPARATING § Confirmation No.: 4102
AN OLIGOMERIZATION REACTOR EFFLUENT §
§
§

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11/26/2007
Edith Shek
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APPEAL BRIEF

Dear Sir:

This Appeal Brief is filed in support for the appeal in the above referenced application and is filed pursuant to the Notice of Appeal filed September 25, 2007. The Applicant authorizes all required fees under 37 C.F.R. § 1.17 to be charged to Deposit Account No. 50-1515, of Conley Rose, P.C. of Texas.

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I. REAL PARTY IN INTEREST

The real party in interest in the instant application is the following party: Chevron Phillips Chemical Company, LP.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF CLAIMS

A. Total Number of Claims in the Application

Claims in the application: 1-35.

B. Status of All Claims in the Application

1. Claims canceled: 17-19, 27, and 35.
2. Claims withdrawn from consideration but not canceled: None.
3. Claims pending: 1-16, 20-26, and 28-34.
4. Claims allowed: None.
5. Claims rejected: 1-16, 20-26, and 28-34.
6. Claims neither rejected nor allowed: None.

C. Claims on Appeal

Claims on appeal: 1-16, 20-26, and 28-34.

IV. STATUS OF AMENDMENTS

No amendments were filed after the June 29, 2007 Final Office Action.

V. SUMMARY OF CLAIMED SUBJECT MATTER

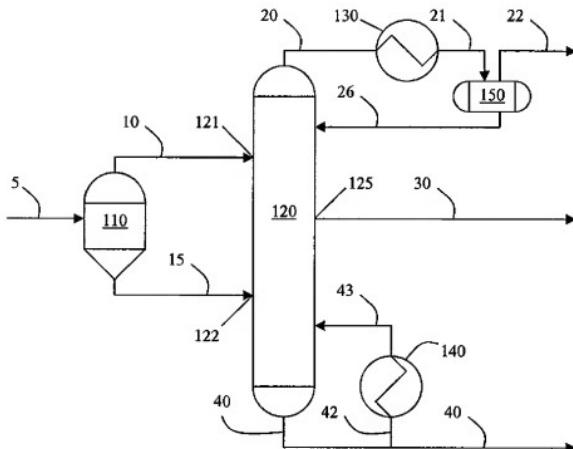
This section provides a concise explanation of the subject matter defined in each of the independent claims involved in the appeal, referring to the specification by page, paragraph, and line number of the paragraph.¹ Each element of the claims is identified with a corresponding reference to the specification where applicable. Note that the citation to passages in the specification for each claim element does not imply that the limitations from the specification should be read into the corresponding claim element.

The purification of oligomerization products, such as 1-hexene, is a complex and expensive process. Generally, 1-hexane is produced by the trimerization of ethylene, which is then separated into four major streams: a 1-hexene stream, an unconverted ethylene stream, a solvent stream, and a heavies stream. The separation of the four major streams is typically performed using three distillation columns. Specifically, the first distillation column produces an ethylene distillate and a bottoms comprising the remaining constituents, which is then fed into a second column where a distillate of high purity 1-hexene is obtained. The bottoms from the second column is fed into a third distillation column that separates the heavies from the solvent. The three-column sequence may be used in the purification of other oligomerization products as well. While a series of single-staged separation processes could be used, the three multi-stage distillation columns described above are needed to achieve the desired product purity. However, such a configuration is undesirable because it is complex to operate and has high capital and operating costs. Therefore, a

¹ 37 C.F.R. § 41.37 (c)(1)(v) provides that the “[s]ummary of claimed subject matter . . . shall refer to the specification by page and line number.” The instant application was presented in numbered page and numbered paragraph form. As such, the citations to the specification support for the claimed subject matter will be presented in the following form: Application at ¶ [____] (paragraph number), lines ____ (lines within the corresponding paragraph). On the occasion when the pertinent paragraph is contained on multiple pages, the paragraph line numbering will begin anew on subsequent pages.

need exists for an improved process for separating an oligomerization reactor effluent into constituent species.

The present application discloses an improved process for separating an oligomerization product, such as high purity 1-hexene, into constituent species. The present application uses a flash drum to reduce the total number of distillation columns needed to separate the oligomerization reactor effluent as compared to a series of distillation towers. This process is illustrated in the following simplified version of FIG. 1:



Simplified Version of FIG. 1

As shown above, the process feeds an oligomerization reactor effluent stream 5 into a vapor/liquid separator 110, commonly referred to as a flash drum. The flash drum 110 has few, if any, internal features and flashes the reactor effluent 5 into a vapor portion 10 and a liquid portion 15. The vapor portion 10 is fed to a distillation column 120 at a vapor feed inlet 121, which is located

above a side draw outlet 125. Similarly, the liquid portion 15 is fed to the distillation column 120 at a liquid feed inlet 122, which is located below the side draw outlet 125. Light components exit the distillation column 120 via an overhead stream 20, which is cooled in a condenser 130 and separated in a reflux drum 150 into a vapor stream 22 and a liquid stream 26. The liquid stream 26 is fed back into the distillation column 120. Heavy components exit the distillation column 120 via a bottoms stream 40, a portion 42 of which passes through a reboiler 140 and are fed back into the distillation column 120 as stream 43. The oligomerization product stream 30 exits the distillation column 120 at the side draw outlet 125. The configuration shown above reduces the number of distillation columns for the separation without reducing the purity of the final oligomerization product. In some cases, the process may include a downstream separation of the solvent from the oligomerization product. The general process configuration is recited in claims 1 and 28, while the product composition is recited in various dependent claims.

Claim 1 recites a method of separating an oligomerization reactor effluent, comprising: (a) flashing the oligomerization reactor effluent into a liquid portion and a vapor portion, *see, e.g.*, Application at ¶ [0010], lines 4-5; (b) feeding the liquid portion of the oligomerization reactor effluent to a liquid feed inlet on a distillation column, *see, e.g.*, Application at ¶ [0010], lines 11-13; (c) feeding the vapor portion of the oligomerization reactor effluent to a vapor feed inlet on the distillation column located above the liquid feed inlet, *see, e.g.*, Application at ¶ [0010], lines 14-16; and (d) withdrawing an oligomerization product stream from a side drawn outlet located between the liquid feed and vapor feed inlets, *see, e.g.*, Application at ¶ [0010], lines 6-16.

Claim 28 recites a system for separating an oligomerization reactor effluent comprising: (a) a vapor/liquid separator to flash the oligomerization reactor effluent into a vapor portion and a liquid portion, *see, e.g.*, Application at ¶ [0017], lines 1-4; and (b) a distillation column in fluid

communication with the vapor/liquid separator, *see, e.g.*, Application at ¶ [0017], lines 9-13, wherein the distillation column has a side draw for withdrawing an oligomerization product stream and receives as separate feeds the vapor portion and the liquid portion from the vapor/liquid separator, *see, e.g.*, Application at ¶ [0022], lines 1-5.

VI. GROUNDS FOR REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-16, 20-26, and 28-34 are unpatentable over WO 03/053890 (*Dixon*) in view of Seader, et al., Perry's Chemical Engineers' Handbook, 7th Ed., New York, McGraw Hill, 1997, pp. 13-4 – 13-9 (*Seader*) under 35 U.S.C. § 103(a).
2. Whether claims 1-13 are unpatentable over WO 99/19280 (*Woodard*) in view of *Seader* under 35 U.S.C. § 103(a).

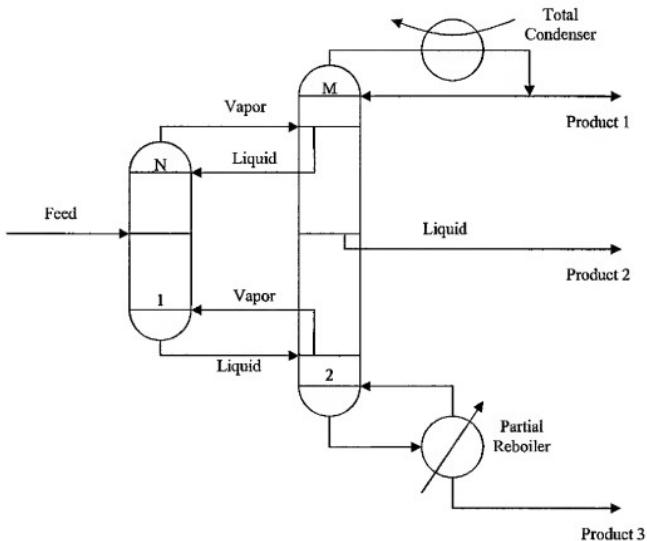
VII. ARGUMENT

A. The Rejection of the Claims

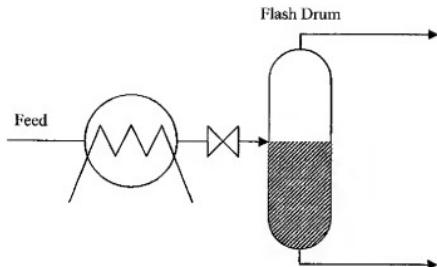
Claims 1-16, 20-26, and 28-34 are pending in the present application and are listed in the attached Claims Appendix. In the Final Office Action dated June 29, 2007 (*Office Action*), claims 1-8, 14-16, 20-26, and 28-34 were rejected under 35 U.S.C. § 103(a) as unpatentable over *Dixon* in view of *Seader*, and claims 1-13 were rejected under 35 U.S.C. § 103(a) as unpatentable over *Woodard* in view of *Seader*. As explained in the *Office Action*, *Dixon* and *Woodard* are cited to teach a method for producing and separating an oligomerization reactor effluent comprising various processing steps, e.g., multiple multi-stage distillation columns. *See Office Action*, pp. 3 and 8-9. However, *Dixon* and *Woodard* fail to teach or suggest several of the claimed limitations, including: flashing the oligomerization reactor effluent into a vapor portion and a liquid portion,

feeding the liquid and vapor portions into a distillation column, and withdrawing an oligomerization product from a sidestream located between the liquid feed inlet and vapor feed inlet. *See claims 1 and 28; Office Action, pp. 3 and 8-9.* Thus, the Examiner turned to *Seader* to make up for the shortcomings in *Dixon* and *Woodard*.

Seader describes numerous separation systems, as well as their advantages and disadvantages. Two of the separation systems described by *Seader* are a multi-stage, thermally-coupled separation system called Petlyuk towers and a single-stage flash drum. These separation systems are shown below:

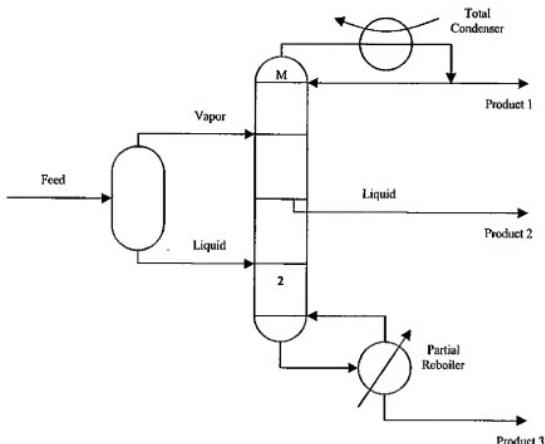


Seader's FIG. 13-6(b): Thermally coupled systems for separation into three products ... Petlyuk towers.



Seader's FIG. 13-7(a): Separation operations related to distillation ... Flash vaporization or partial condensation.

Seader does not teach the separation system disclosed by the Applicant. Instead, the Examiner creates a new separation system (the *Examiner-Modified Pettyuk System*) by combining the two distinct separation systems shown above. Specifically, the Examiner substitutes the flash drum for the prefractionator in the Pettyuk towers to create the *Examiner-Modified Pettyuk System*, as shown below:



The Examiner-Modified Pettyuk System

Only by creating this *Examiner-Modified Petlyuk System* and combining it with *Dixon* or *Woodard* is the Examiner able to achieve the separation system recited in the claims. As discussed below, the *Examiner-Modified Petlyuk System* is a prohibited modification of *Seader*, and thus cannot be combined with either *Dixon* or *Woodard* to reject the pending claims.

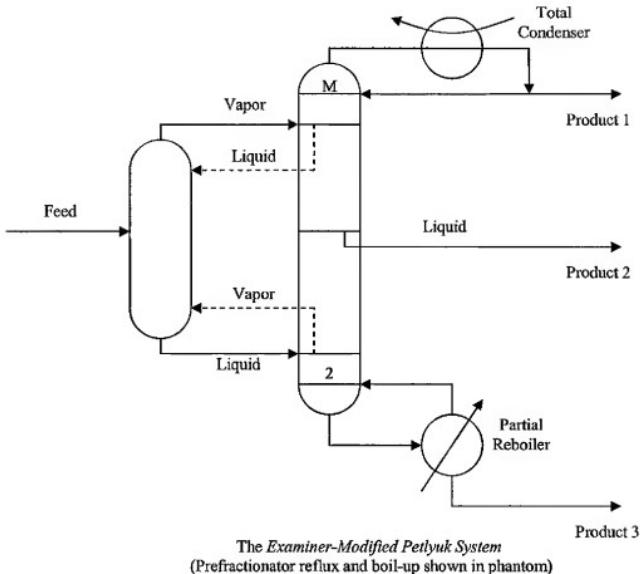
B. *The Examiner-Modified Petlyuk System Changes the Principle of Operation of the Petlyuk Towers*

The *Examiner-Modified Petlyuk System* is a prohibited modification of *Seader* because the *Examiner-Modified Petlyuk System* changes the principle of operation of the Petlyuk towers. It is well accepted that if a proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. See, e.g., *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). *Seader* teaches that Petlyuk towers are a thermally-coupled system in that the second column is the sole source of heating and cooling for the prefractionator. Specifically, *Seader* states:

The thermally coupled system in Fig. 13-6b, discussed by Stupin and Lockhart [citation omitted] and referred to as Petlyuk towers, is particularly useful for reducing energy requirements when the initial feed contains close-boiling species. ... Products from the prefractionator are sent to appropriate feed trays in the second column, where all three products are produced, the middle product being taken off as a sidestream. Only the second column is provided with [a] condenser and reboiler; **reflux and boil-up for the prefractionator are obtained from the second column.**

Seader, pp. 13-5. As described above, the prefractionator and column of the Petlyuk towers are thermally coupled in that the reflux and boil-up for the prefractionator are provided by the distillation column. To achieve the thermal coupling required for the Petlyuk towers, the prefractionator requires at least three inputs: a feed, a reflux, and a boil-up. The reflux and the boil-up come from the second column into which the two prefractionator's distillate and bottoms

are fed. Recall that the *Examiner-Modified Petlyuk System* substitutes a flash drum for the prefractionator in the Petlyuk towers. As described by *Seader*, a flash drum has a single inlet stream and two effluent streams, and does not receive either a reflux or a boil-up. See *Seader*, pp. 13-6 and Fig. 13-7a. Thus, the *Examiner-Modified Petlyuk System* eliminates the reflux and boil-up streams, as shown in phantom below:



As shown above, the elimination of the reflux and boil-up eliminates the thermal coupling in the Petlyuk towers. Because the Petlyuk towers operate via the principle of thermal coupling, the elimination of the thermal coupling changes the principle of operation of the Petlyuk towers. As such, the *Examiner-Modified Petlyuk System* is a prohibited modification of *Seader*, and cannot be combined with *Dixon* or *Woodard* to reject the pending claims.

C. Seader Teaches Away from the Substitution of the Flash Drum for the Prefractionator in the Examiner-Modified Petlyuk System

The *Examiner-Modified Petlyuk System* is a prohibited modification of *Seader* because *Seader* teaches away from the substitution of the flash drum for the prefractionator in the Petlyuk towers. It is well accepted that it is improper to combine references where the references teach away from their combination. *See, e.g., In re Grasselli*, 713 F.2d 731, 218 USPQ 769 (Fed. Cir. 1983). *Seader* teaches that the Petlyuk towers and the flash drum are used in separate, distinct instances. Specifically, *Seader* states:

Petlyuk towers [are] particularly useful for reducing energy requirements when the initial feed contains close-boiling species. Shown for a ternary feed, the first column in Fig. 13-6b is a prefractionator, which sends essentially all of the light component and heavy component to the distillate and bottoms respectively, but permits the component of intermediate volatility to be split between the distillate and bottoms.

Seader, pp. 13-5. As described above, *Seader* teaches that the Petlyuk towers are suitable for those instances where: (1) the relative volatility between components is small, (2) essentially all of the light component is produced in the prefractionator's distillate, (3) essentially all of the heavy component is produced in the prefractionator's bottoms, and (4) substantially all of the heavy and light components are to be separated from each other. With regards to flash drums, *Seader* states:

A single-stage flash, as shown in Fig. 13-7a, may be appropriate if (1) the relative volatility between the two components to be separated is very large; (2) the recovery of only one component, without regard to the separation of the other components, in one of the two product streams is to be achieved; or (3) only a partial separation is to be made.

Seader, pp. 13-6. As described above, the flash drum is suitable for those situations where: (1) the relative volatility between components is very large, (2) essentially all of one component is produced in one stream without regards for the amount of the other component produced in the other stream, and (3) only a partial separation of the light and heavy components is desired.

Assuming that the flash drum produces a distillate comprising essentially all of the light component, these differences may be highlighted in the following table²:

Table 1: Comparison Between the Petlyuk Columns' Prefractionator and the Flash Drum

Property	Petlyuk Towers' Prefractionator	Flash Drum
Relative volatility between the light and heavy components	Small	Very Large
Amount of heavy component in the distillate	Essentially none	Some, but not all - The recovery of the light component is made without regards to recovery of the heavy component
Amount of heavy component in the bottoms	Essentially all	Some, but not all - The recovery of the light component is made without regards to recovery of the heavy component
Separation between light and heavy components	Substantially Complete	Partial

As shown in the above table, *Seader* teaches that either the Petlyuk towers' prefractionator or the flash drum would be used, depending on the feed composition and desired separation. For example, the Petlyuk towers' prefractionator is used for substantially complete separation of two components, whereas the flash drum is used for partial separation of two components. The flash drum would not provide the same separation as the Petlyuk towers' prefractionator, and therefore would not provide the separation required to enable the second column to perform the desired separation. Consequently, the flash drum and Petlyuk towers' prefractionator are mutually exclusive separation devices. Because *Seader* teaches that the Petlyuk towers' prefractionator and the flash drum are mutually exclusive separation devices, *Seader* teaches away from the substitution of the flash drum for the Petlyuk towers' prefractionator. As such, the *Examiner-*

² An assumption that the flash drum produces a bottoms comprising substantially all of the heavy component would yield a similar table, but with the heavy component terms and light component terms switched.

Modified Petlyuk System is a prohibited modification of *Seader*, and cannot be combined with *Dixon* or *Woodard* to reject the pending claims.

VIII. CONCLUSION

In view of the above arguments, the Applicant respectfully requests that the final rejection of the claims be reversed and the case advanced to issue. Should the Examiner feel that a telephone interview would advance prosecution of the instant application, Applicant invites the Examiner to call the attorneys of record.

The Commissioner is hereby authorized to charge payment of any further fees associated with any of the foregoing papers submitted herewith, or to credit any overpayment thereof, to Deposit Account No. 50-1515, of Conley Rose, P.C. of Texas.

Respectfully submitted,
CONLEY ROSE, P.C.

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IX. CLAIMS APPENDIX

The text of the claims involved in the appeal is:

1. A method of separating an oligomerization reactor effluent, comprising:
 - (a) flashing the oligomerization reactor effluent into a liquid portion and a vapor portion;
 - (b) feeding the liquid portion of the oligomerization reactor effluent to a liquid feed inlet on a distillation column;
 - (c) feeding the vapor portion of the oligomerization reactor effluent to a vapor feed inlet on the distillation column located above the liquid feed inlet; and
 - (d) withdrawing an oligomerization product stream from a side drawn outlet located between the liquid feed and vapor feed inlets.
2. The method of claim 1, wherein the oligomerization reactor effluent is from a trimerization reactor.
3. The method of claim 1, wherein the oligomerization reactor effluent is from trimerization of ethylene to 1-hexene.
4. The method of claim 3, wherein the oligomerization reactor effluent comprises a solvent.
5. The method of claim 4, wherein the solvent comprises an aliphatic solvent, an aromatic solvent, or combinations thereof, having from 3 to 9 carbon atoms.

6. The method of claim 4, wherein the solvent comprises cyclohexane, methylcyclohexane, hexane, 1-hexene, C₇ hydrocarbons, isobutane, propane, or mixtures of two or more thereof.
7. The method of claim 4, wherein the solvent comprises cyclohexane.
8. The method of claim 7, wherein the oligomerization reactor effluent comprises a catalyst system.
9. The method of claim 8, wherein the catalyst system comprises a chromium source, a pyrrole-containing compound, a methyl alkyl, and a halide source.
10. The method of claim 9 further comprising killing the catalyst system prior to step 1(b).
11. The method of claim 10, wherein the catalyst system is killed with an alcohol, an amine, or combinations thereof.
12. The method of claim 10, wherein the catalyst system is killed with an alcohol having eight to twelve carbon atoms per molecule.
13. The method of claim 10, wherein the catalyst system is killed with C₈ alcohol.
14. The method of claim 1, wherein the oligomerization product stream comprises 1-hexene and solvent.

15. The method of claim 1, wherein the oligomerization reactor effluent is flashed by pressure reduction.

16. The method of claim 1, wherein the distilling is performed in a common distillation column.

17-19. (Cancelled)

20. The method of claim 1 further comprising a number of stages between the liquid feed inlet and the side draw outlet effective to separate heavies from the oligomerization product stream.

21. The method of claim 1 further comprising a number of stages between the vapor feed inlet and the side draw outlet effective to separate lights from the oligomerization product stream.

22. The method of claim 1 further comprising separating 1-hexene and cyclohexane from the oligomerization product stream.

23. The method of claim 1, wherein the oligomerization reactor effluent comprises:
from about 15 to about 30 wt. % 1-hexene,
from about 5 to about 15 wt. % ethylene,
from about 50 to about 80 wt. % cyclohexane,
from about 5 to about 20 wt. % lights, and
from about 0 to about 3 wt. % heavies.

24. The method of claim 1, wherein the liquid portion comprises:

from about 15 to about 30 wt. % 1-hexene,
from about 0 to about 5 wt. % ethylene,
from about 50 to about 80 wt. % cyclohexane,
from about 0 to about 5 wt. % lights, and
from about 0 to about 5 wt. % heavies.

25. The method of claim 1, wherein the vapor portion comprises:

from about 15 to about 25 wt. % 1-hexene,
from about 25 to about 50 wt. % ethylene,
from about 20 to about 40 wt. % cyclohexane,
from about 25 to about 50 wt. % lights, and
from about 0 to about 0.5 wt. % heavies.

26. The method of claim 1, wherein the oligomerization product stream comprises:

from about 15 to about 30 wt. % 1-hexene,
from about 0 to about 0.1 wt. % ethylene,
from about 70 to about 85 wt. % cyclohexane,
from about 0 to about 0.1 wt. % lights, and
from about 0 to about 1 wt. % heavies.

27. (Canceled)

28. A system for separating an oligomerization reactor effluent comprising:

- (a) a vapor/liquid separator to flash the oligomerization reactor effluent into a vapor portion and a liquid portion; and
- (b) a distillation column in fluid communication with the vapor/liquid separator, wherein the distillation column has a side draw for withdrawing an oligomerization product stream and receives as separate feeds the vapor portion and the liquid portion from the vapor/liquid separator.

29. The system of claim 28, wherein the liquid portion is fed to the distillation column at a location below the side draw.

30. The system of claim 29, wherein the vapor portion is fed to the distillation column at a location above the side draw.

31. The system of claim 28 further comprising a trimerization reactor for providing the oligomerization reactor effluent, wherein the trimerization reactor is in fluid communication with the vapor/liquid separator.

32. The system of claim 28, wherein the vapor/liquid separator is positioned at an elevation higher than the liquid feed on the distillation column to create a hydrostatic head for flow into the distillation column.

33. The system of claim 28 further comprising a second distillation column in fluid communication with the side draw of the first distillation column, wherein the second distillation column separates trimerization product from solvent.

34. The system of claim 28, wherein the distillation column has at least 3 off-takes and at least 2 inputs.

35. (Cancelled)

X. EVIDENCE APPENDIX

None.

XI. RELATED PROCEEDINGS APPENDIX

None.